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2. BACKGROUND

This section provides a discussion of the historical discharge of PCBs and the regulatory history of the site, and a description of the physical setting of the Housatonic River watershed. The following two sections draw heavily on existing information and recent reports prepared as part of the Housatonic River investigation; many sections are taken from the Source Characterization Report (WESTON, 1998a) and the Supplemental Investigation Work Plan (WESTON, 2000a).

2.1 SITE HISTORY AND REGULATORY BACKGROUND

2.1.1 Site History

The following section on site history was extracted from the Supplemental Investigation Work Plan prepared by Roy F. Weston, Inc. (WESTON, 2000a):

> The Housatonic River is located in the center of a rural area of western Massachusetts where farming was the main occupation from colonial settlement through the late 1800s. As with most rivers, the onset of the industrial revolution in the late 1800s brought manufacturing to the banks of the Housatonic River. The manufacture of paper and textiles began in Pittsfield and the area to the south during the late 19th century. The city's manufacturing base grew to include machinery and electrical transformers during the early 20th century, when industries such as the Stanley Electric Company and the Berkshire Gas Company and its predecessors occupied portions of the property near the intersection of East Street and Merrill Road. GE began its operations in its present location in 1903. Three manufacturing divisions have operated at the GE facility (Transformer, Ordnance, and Plastics).
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> The GE plant in Pittsfield has historically been the major handler of PCBs in western Massachusetts, and is the only known source of PCB wastes discovered in the Housatonic River sediments and floodplain between Pittsfield and Lenox. Although GE performed many functions at the Pittsfield facility throughout the years, the activities of the Transformer Division were the likely primary source of PCB contamination. Briefly, GE's Transformer Division's activities included the construction and repair of electrical transformers using dielectric fluids, some of which contained PCBs (primarily mixtures referred to as Aroclors 1254 and 1260). GE manufactured and serviced electrical transformers containing PCBs at this facility from approximately 1932 through 1977.
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> According to GE's reports, from 1932 through 1977 releases of PCBs reached the wastewater and storm systems associated with the facility and were subsequently conveyed to the East Branch of the Housatonic River and to Silver Lake (Supplemental Phase II/RCRA Facility Investigation Report for Housatonic River and Silver Lake,

Volume I, by BBL, January 1996). In or around 1968, a 1,000-gallon PCB storage tank located in Building 68 of the GE facility collapsed, releasing liquid Aroclor 1260 onto the riverbank soil and into the Housatonic River. Based on visual observation, Aroclor-contaminated soils and sediments were excavated by GE and eventually landfilled; however, significant contamination remains as a result of this release.

During the 1940s, efforts to straighten the Pittsfield reach of the Housatonic River by the City of Pittsfield and the U.S. Army Corps of Engineers (USACE) resulted in 11 former oxbows being isolated from the river channel. These areas were filled with materials that were later discovered to contain PCBs and other hazardous substances.

Areas of the 254-acre GE manufacturing facility; the Housatonic River, riverbanks, and associated floodplains from Pittsfield, MA, to Rising Pond Dam (approximately 30 miles); former river oxbows that have been filled; neighboring commercial properties; Allendale School; Silver Lake; and other properties or areas have become contaminated as a result of GE's facility operations.

Surface water runoff from sources, flooding of sources by the Housatonic River, migration of nonaqueous phase liquids, direct discharge of PCB fluids from the Building 68 tank implosion, and groundwater discharge from the sources to the Housatonic River have been interpreted as the cause of the sediment contamination in the Housatonic River. Migration and redistribution of sediments contaminated with Aroclor 1254 and 1260 and other hazardous materials within the Housatonic River have further resulted in contamination detected in the floodplain downstream from the site.

Numerous studies conducted since 1988 have documented PCB contamination of soils within the floodplain of the Housatonic River downstream of the GE plant and former oxbows. Most of the floodplain soil PCB contamination (exceeding 1 ppm total PCBs) detected historically falls within the approximate extent of the river's 5-year floodplain. PCBs have also been detected in sediments beyond the Massachusetts/Connecticut state line, located approximately 46 miles below the facility. PCB contamination downstream is believed to result from the redistribution by flooding of PCB wastes released from wastewater discharge, flooding of source areas by the Housatonic River, migration of nonaqueous phase liquids, and direct discharge of PCB fluids from the Building 68 tank implosion and groundwater discharge from the sources to the Housatonic River have been interpreted as the cause of the sediment contamination in the Housatonic River. In some cases, the contaminated soil is located on residential properties and within 200 ft of the residences on these properties. Other contaminated areas include parts of the Audubon Society's Canoe Meadow Wildlife Sanctuary and the Housatonic River Valley State Wildlife Management Area. The Housatonic River was closed to all but catch and release fishing from Dalton, MA, to the Connecticut border by the MADEP in 1982 as a result of PCB contamination in the river sediments and fish tissues, and sections of the river in Connecticut were posted earlier due to PCB contamination. In addition, MADEP issued a consumption advisory for ducks taken from the river between Pittsfield and Rising Pond in 1999. Concerns expressed by local residents regarding possible health effects resulting from exposure to PCB contamination are being investigated by the Massachusetts Department of Public Health.

Analyses of sediment samples collected upstream of the GE site reveal trace or non-detectable concentrations of Aroclor 1254 or 1260. Beginning at the confluence of Unkamet Brook and the Housatonic River, either Aroclor 1254, or 1260, or both, as well as other hazardous substances, have been detected in samples collected at the GE facility, and from within the banks and floodplain of the Housatonic River. The highest concentrations of Aroclor 1254 and 1260 have been detected near the GE facility in the vicinity of the site, downstream of the former Building 68 PCB spill. Previous investigations suggest that the majority of the PCB-contaminated sediment and floodplain soil is found above Woods Pond.

The Housatonic River flowed through the City of Pittsfield in its natural state until the 1940s when the river was channelized within the City of Pittsfield, isolating several oxbows. In addition, the Massachusetts Department of Public Works undertook flood control work based on reports by the USACE. Work within the site area included the East Branch within the City of Pittsfield, and the riverbanks above and below Woods Pond. The river's course is relatively unaffected (with the exception of the dams discussed below) in areas south of the city.

The many dams that are part of the historical development of the Housatonic River may have potentially affected the downstream distribution of PCBs and other contaminants from the GE facility. Multiple dams were constructed on the Housatonic River as industrial development created a demand for water power, water supplies, and hydroelectric power. There are a total of 13 dams on the river in Massachusetts and 5 dams on the river in Connecticut. Between the confluence of the East and West Branches of the Housatonic River and the Connecticut state line, there are six dams: one at Woods Pond in Lee, MA; two other small dams in Lee, MA; two small dams in Stockbridge and the Village of Housatonic; and one at Rising Pond near Great Barrington.

2.1.2 Site Regulatory Background

The GE Housatonic River site has been subject to regulatory investigations dating back to the late 1970s. These investigations were consolidated under two regulatory mechanisms: an Administrative Consent Order (ACO) with the Massachusetts Department of Environmental Protection (MADEP) and a Corrective Action Permit with the U.S. Environmental Protection Agency (EPA) under the Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act (RCRA).

In 1991, EPA issued a RCRA Corrective Action Permit to the GE facility. Following an appeal and subsequent modification, the permit was reissued in 1994. The permit included the 254-acre facility, Silver Lake, the Housatonic River and its floodplains and adjacent wetlands, and all sediments contaminated by PCBs migrating from the GE facility.

In addition to the permit, the ACO between GE and MADEP became effective in 1990 and included those areas defined in the permit as well as three additional study areas: Newell Street Area I, the Former Housatonic River Oxbows, and the Allendale School Property. Under the ACO, GE has performed several investigations and short-term cleanups.

In September 1998, representatives of EPA, MADEP, U.S. Department of Justice (DOJ), Connecticut Department of Environmental Protection (CTDEP), the City of Pittsfield, GE, and others reached a comprehensive agreement relating to the GE facility and the Housatonic River. This agreement provides for the investigation and cleanup of the Housatonic River and associated areas. In addition, the agreement provides for the cleanup and economic redevelopment of the GE facility, environmental restoration of the Housatonic River, compensation for natural resource damages, and government recovery of past and future response costs.

Under the scope of the agreement, EPA will conduct additional characterization sampling to determine the nature and extent of contamination, as well as to support the conduct of human health and ecological risk assessments, and surface water modeling.

The agreement includes the following actions for the "Rest of River," the river below the confluence of the East and West Branches.

- EPA/MADEP to conduct additional sampling, human health and ecological risk assessments, and modeling, and will submit both risk assessments and modeling for Peer Review.
- GE to compile all data into a RCRA Facility Investigation (RFI) report and a Corrective Measures Study (CMS).
- The governments intend to submit drafts of major technical documents to the Citizens Coordinating Council for review and discussion.
- At the conclusion of the studies, EPA will issue a Statement of Basis and modify the RCRA permit.
- GE agrees to perform cleanup unless it invokes dispute resolution:
    - Review process can include both internal EPA and federal court review.

- During dispute resolution, all work not subject to the dispute continues, and EPA can proceed with designing disputed aspects of cleanup.

- GE to perform cleanup as determined after dispute resolution.

This agreement was codified in a Consent Decree (00-0388, 00-0389, 00-0390) lodged in U.S. District Court, Massachusetts, Western Division, in October 1999.

2.2 PHYSICAL SETTING AND BACKGROUND

The Housatonic River is located in the center of a rural area of western Massachusetts in Berkshire County. The river and its tributaries lie in an alluvial plain with the Berkshire Hills to the east and the Taconic Range to the west. Elevations of the drainage basin range from sea level at the river mouth in Connecticut to 2,600 ft above sea level at Brodie Mountain, Massachusetts. The elevation of the riverbed at the GE facility in Pittsfield is 972 ft (msl) and at the Massachusetts-Connecticut border the elevation is approximately 650 ft (msl).

The river flows approximately 150 miles from near Pittsfield, MA, to Long Island Sound and drains an area of approximately 1,950 square miles in Massachusetts, New York, and Connecticut. Within Massachusetts, the river drops approximately 600 ft and drains an area of about 500 square miles. Studies have focused on the 52-mile section of the river from Dalton, MA, to the Massachusetts-Connecticut border (see Figure 1-1). The topography near the GE facility (located on the East Branch north of the confluence with the West Branch) is generally flat with little or no relief. Bordering areas slope mildly toward the Taconic Range to the north and west. The facility is adjacent to an area of flat and swampy land to the south and east that borders highlands rising sharply to Tully and Day Mountains.

The section of the river in Massachusetts is located in the Humid Temperate Domain, Warm Continental Mountains, Adirondack–New England Mixed Forest–Coniferous Forest–Tundra ecoregion. This province is composed of subdued glaciated mountains and maturely dissected plateaus of mountainous topography. Many glacially broadened valleys have glacial outwash deposits and contain numerous swamps and lakes. The forests within this ecoregion are characterized by sugar maple, yellow birch, beech, and a mixture of hemlock within valleys. Low mountain slopes contain spruce, fir, maple, beech, and birch.

Land use in the area around the GE facility is primarily commercial and residential. The GE facility is mainly surrounded by residential areas: Brattle Brook Park, residential neighborhoods, and several schools are located within a 1-mile radius of the facility. Rainfall and melting snow are the main water sources that feed the Housatonic River systems. The average annual precipitation in this river basin is approximately 46 inches per year. Approximately 24 inches per year leave the basin as runoff through the Housatonic River, another 20 inches per year escape to the atmosphere by evaporation and transpiration, while the remaining 2 inches per year infiltrate into the ground.

The three tributaries feeding the Housatonic River in the area of the GE facility are Barton Brook, Brattle Brook, and Unkamet Brook. The watershed of these tributaries and the East Branch of the Housatonic River is considered a well-drained area with 0.13 to 0.17 million gallons per day per square mile flowing as runoff. Groundwater also discharges into the river in the area of the GE facility, contributing to the river flow.

The flood potential of the Housatonic River Basin has been documented in various studies by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS), the USGS, and USACE. A mapping study was performed by GE between the USGS gaging station in Coltsville and the Connecticut state line. This study shows the extent of 10-year floodplains found by interpolating data from a FEMA report and using data from HEC-2 modeling. The 10-year floodplain is quite narrow adjacent to the GE facility. Downstream of the facility within the Pittsfield City limits, the floodplain widens and includes numerous residential and commercial areas.

The watershed study area for the modeling effort encompasses the entire Housatonic River watershed, beginning at the headwaters, down to the USGS gage in Great Barrington, MA, draining an area of approximately 282 square miles. In addition to the overall watershed area, the section of the river from the confluence of the East and West Branches to the Woods Pond Dam (see Figure 1-1) and the associated 10-year floodplain forms the domain of the detailed river modeling study described herein.

The current modeling effort will include the river reaches downstream to Woods Pond because of the higher concentration of PCBs in the sediments in the main channel and PCBs accumulated

in Woods Pond, the first large depositional area downstream of the GE facility. The following reaches have been defined from Dalton to Woods Pond (Figure 2-1): (1) Dalton to Unkamet Brook; (2) Unkamet Brook to Newell Street Bridge; (3) Newell Street Bridge to Lyman Street Bridge; (4) Lyman Street Bridge to Confluence of the West and East Branches; (5) Confluence to Woods Pond; and (6) Woods Pond. The physical characteristics of each reach provide some insight into the likely physical transport processes that are occurring within them. Data presented in this brief discussion are taken from Table 2.3-1 and Table 2.3-2 in *Volume I, Final Supplemental Investigation Work Plan for the Lower Housatonic River* (WESTON, 2000a).

Reach 1: Dalton to Unkamet Brook. In the upper section of the Housatonic River from Hubbard Street in Dalton (the location of the USGS Coltsville gage) to the confluence with Unkamet Brook, the channel slope (29.4-42.2 ft/mile) is relatively steep with the riverbed elevation dropping 121 ft over this 2.8-mile section. In this section of the study area, the river alternates between an E-W and N-S orientation and has a narrow floodplain as a result of a portion of the river being previously channelized. The width of the river averages approximately 15 meters with typical water depths varying from 1 to 2 ft. In this steep section of the river, flow is moderate with sediment bed properties characterized as having a depositional area near Unkamet Brook with cobble, gravel, and boulders as the dominant substrate in the upper portions of this reach.

Reach 2: Unkamet Brook to Newell Street Bridge. In this reach of the East Branch of the Housatonic River, the channel slope (4.8 ft/mile) is considerably more gradual than Reach 1 with the riverbed elevation dropping 10 ft over this 2.0-mile section. The river, characterized by both meanders and a channelized section, is oriented roughly NE-SW with a wider floodplain than in Reach 1. The width of the river in this reach typically averages 15 meters with average water depths ranging from 0.2 to 5.0 ft. In this section of the river, flow is slow to moderate with bed features characterized by terrace, channel, and aggrading bar deposits.

Reach 3: Newell Street Bridge to Lyman Street Bridge. In this urbanized reach of the East Branch of the Housatonic River, the channel slope (6.9 ft/mile) is slightly steeper than Reach 2 with the riverbed elevation dropping 3 ft over this 0.5-mile section. The channelized river is oriented roughly NE-SW with a negligible floodplain. The width of the river in this reach is about 12 to 20 meters with average water depths ranging from 1 to 3.5 ft. In this reach, flow is slow to moderate with sediment bed properties characterized by cobbles, gravel, and coarse sands with very little silt and clay.

Reach 4: Lyman Street Bridge to Confluence of West and East Branches. In this channelized reach, the channel slope (4.7 ft/mile) is slightly less steep than Reach 3, with the riverbed elevation dropping 7 ft over this 1.4-mile reach. The channelized river is oriented roughly NNE-SSW with a small floodplain near the confluence with the West Branch. The width of the river in this reach is about 12 to 20 meters with average water depths ranging from 0.2 to 4 ft. In this reach, flow is slow to fast with sediment bed properties characterized by cobbles, gravel, and coarse sands with very little silt and clay.

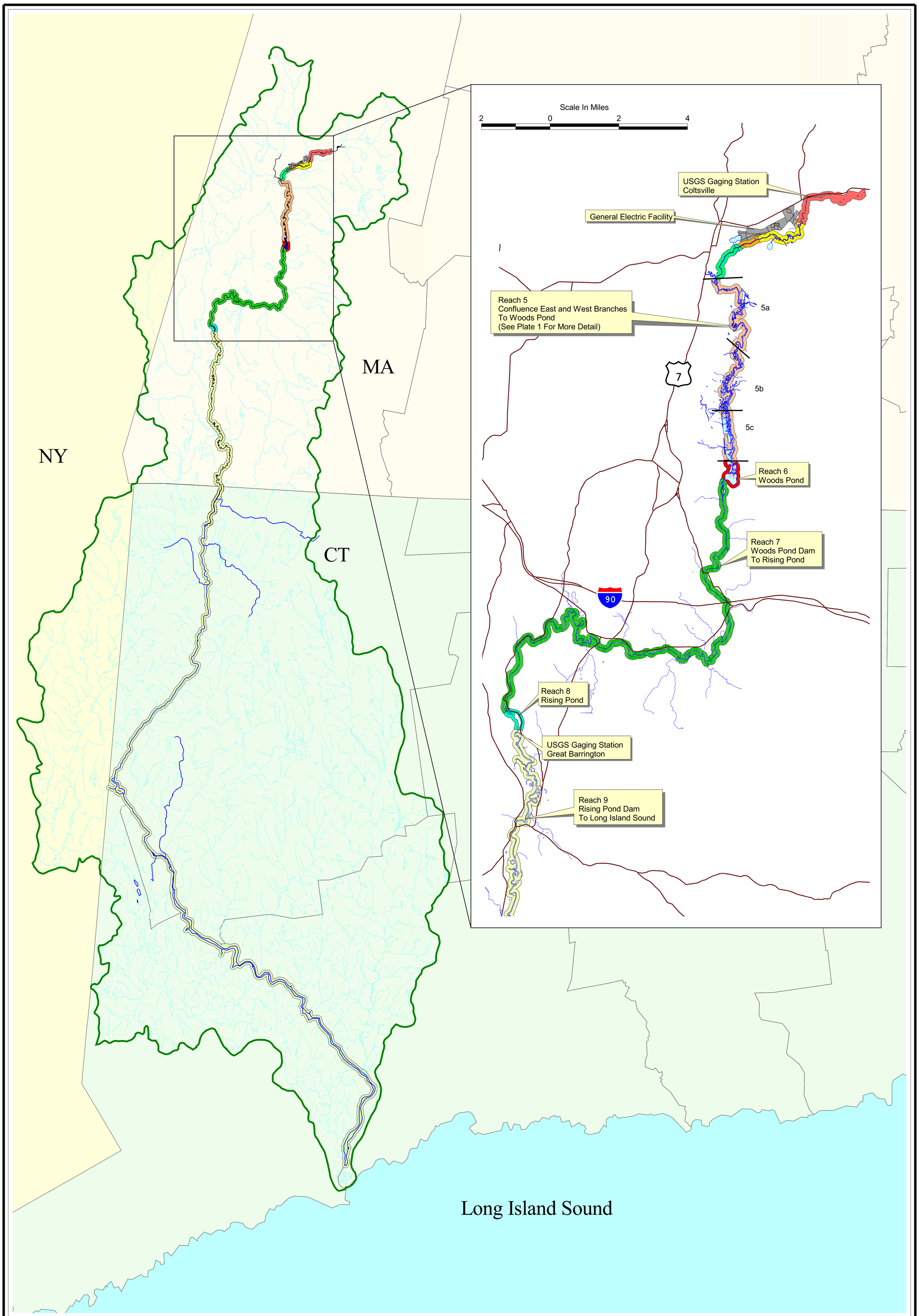
Reach 4a from Pomeroy Avenue Bridge to the confluence with the West Branch is downstream of the channelized reach.

Reach 5: Confluence to Woods Pond. From the confluence of the West and East Branches to the headwaters of Woods Pond, the channel slope (1.6 ft/mile) is very gradual over this 8.0-mile reach with the riverbed elevation dropping 13 ft to the confluence of Woods Pond. Reach 5 is characterized as having two different flow regimes; one that is essentially free-flowing (*Reaches 5a and 5b*) and the other where flows are subject to the backwater influences (*Reach 5c*) caused by Woods Pond Dam. These subreaches are shown on Plate No. 1.

Reach 5a downstream of the confluence with the West Branch to the Wastewater Treatment Plant (WWTP) and *Reach 5b* downstream from the WWTP to Roaring Brook are characterized by a free-flowing river, oriented roughly NNW-SSE, with a wide floodplain and numerous meanders and remnant oxbows and riverbanks that are generally scoured and eroded. The width of the meandering river in the free-flowing section is about 15 to 36 meters with depths up to 10 ft. Reflecting the generally slow velocity characteristics of this flat reach, the sediment bed consists of coarse to fine sands with approximately 10% silts and clay.

Reach 5c downstream of the confluence with Roaring Brook is the section of Reach 5 where flows are influenced by a backwater effect from the Woods Pond Dam; the river, oriented approximately N-S, is characterized by a broad wetland floodplain (~800- to 3,000-ft width) on the west bank with numerous backwater areas, channels, and meanders. The inundated remnant floodplain is easily visible in this section of the river as broad and shallow backwater "embayments" with stands of emergent vegetation, macrophytes, and surface algal mats. On the east bank of the river the narrow floodplain is confined by the steep slopes of October Mountain. The width of the river channel ranges from about 18 to 48 meters with depths of 4 to 8 ft. Under high-flow conditions, the numerous backwater areas are hydraulically connected to flow in the main river channel; under low-flow conditions, however, the backwater areas appear to be largely isolated from the influence of flows in the main river channel. The depositional sediment bed is characterized predominantly by fine sands and silts.

Reach 6: Woods Pond. Woods Pond is a broad, shallow, 60-acre impoundment of the Housatonic River formed by construction of the Woods Pond Dam in the early 1900s; the adjacent upstream deep channel (*Reach 6a*) and backwater areas (*Reach 6b*) account for an additional 62 acres. These subreaches are shown on Plate No. 1. The remnant river channel on the eastern and southern shores of Woods Pond is considerably deeper (maximum depth ~16 ft) than the shallower depths (~1 to 3 ft) of the remnant floodplain to the west and north that are characterized by stands of emergent macrophytes and dense surface algal mats. A deep "hole" of approximately 16 ft depth, is located in the southeastern area of the remnant stream channel (*Reach 6c*). The "hole" is further characterized by a thick deposit (~16 ft) of soft silty-clay sediments that has accumulated over the past 100 years since construction of the Woods Pond Dam. In the shallow remnant floodplain areas of Woods Pond (*Reach 6d*), the sediments are silt and clay with a high organic content. Although the broad, shallow



Housatonic River Project
Pittsfield, Massachusetts

FIGURE 2-1
HOUSATONIC RIVER REACHES
1 TO 9

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areas of Woods Pond are well-mixed, the "deep hole" exhibits some thermal stability and dissolved oxygen stratification during the summer.

Reaches 7, 8, and 9 include the river sections from Woods Pond to Rising Pond, Rising Pond, and downstream of Rising Pond, respectively. These reaches include five dams below the Woods Pond Dam and five dams in Connecticut. Although the modeling activity does not incorporate these reaches, they are included in the "Rest of River" defined in the Consent Decree (October 1999) and extend through Connecticut. These lower reaches may be the focus of later modeling studies.